Before the
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

In the Matter of	)	
	)	
The Establishment of Policies and	)	
Service Rules for the Non-Geostationary	)	IB Docket No. 01-96
Satellite Orbit, Fixed Satellite Service	)	
in the Ku-Band	)	
	)	

COMMENTS OF SKYBRIDGE

SkyBridge L.L.C. ("SkyBridge"), by its attorneys, hereby submits its comments on the Further Notice of Proposed Rulemaking ("FNPRM") in the above-captioned proceeding.[1] The FNPRM seeks comment on proposals for refining the regime adopted by the Commission for sharing among non-geostationary satellite orbit ("NGSO") Fixed-Satellite Service ("FSS") systems in the Ku-band, and also on methods for ensuring compliance with the aggregate equivalent power flux-density ("EPFD") limits that apply collectively to such systems.

I. NGSO/NGSO SHARING

In the Report and Order in this proceeding, the Commission adopted a method for sharing among Ku-band NGSO FSS systems based on avoidance of "in-line events" between satellites of different systems.[2] With this method, each satellite will be able to employ

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[1] FCC 01-134, rel. May 3, 2001 (the "FNPRM"). The FNPRM was issued in conjunction with a Report and Order (the "R&O") establishing sharing and service rules for Ku-band NGSO FSS systems. *See also* Comments of SkyBridge, IB Docket No. 01-96, July 6, 2001 (the "SkyBridge Comments"); Reply Comments of SkyBridge, IB Docket No. 01-96, August 6, 2001 (the "SkyBridge Reply Comments").

[2] R&O, ¶ 27.

all of the available spectrum most of the time, but will be required to avoid transmitting in a portion of the spectrum when it is "in-line" with a satellite of another system. To define an "in-line event", the Commission adopted an Earth-surface based (topocentric) angular separation of 10°.[3] From that baseline, individual operators can coordinate to make more efficient use of the spectrum.

In the FNPRM, the Commission notes that it could optimize spectrum efficiency for the NGSO FSS systems by refining the angular separation definition of an in-line event.[4] Such refinement is necessary, however, only in cases in which the incentives to coordinate may fail, particularly if this leaves some systems inadequately protected. As SkyBridge has explained, while 10° angular separation represents an appropriate balance for sharing between most of the proposed NGSO FSS systems, it may be insufficient to protect one system against another system that is using significantly higher power levels combined with high off-axis gain.[5] As the Commission recognizes, it is therefore necessary address the case of the "high power" system.[6]

SkyBridge proposed defining a "high-powered uplink"[7] as one with an on-axis PFD in excess of 18 dBW/m^2/40 kHz *and* an off-axis PFD at 10-degrees or greater in excess of

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3 Id., ¶ 49.

4 FNPRM, ¶ 86.

5 SkyBridge L.P. *Ex Parte* Filing in File Nos. 48-SAT-P/LA-97, 89-SAT-AMEND-97, 130-SAT-AMEND-98, and ET Docket No. 98-206 (January 31, 2002) ("SkyBridge January 2002 *Ex Parte*").

6 FNPRM, ¶ 89.

7 High power is not a concern on the downlink. The downlink EPFD limits adopted for the protection of GSO earth stations constrain all NGSO systems to similar downlink power levels. However, the uplink EPFD limits adopted for the protection of GSO satellites are not as tightly constraining, and the fact that the orbital altitudes proposed by the NGSO

-10 dBW/m^2/40 kHz.[8] Both prongs of this definition are important. A terminal with a relaxed antenna pattern may not adversely affect other systems if its power is low (which may be the case for a LEO, for example). Similarly, a terminal with a high on-axis power (such as a MEO or HEO) may not adversely affect another system if its antenna performance or diameter is high. A separation angle larger than 10° is needed only when a system employs a high uplink power transmitted from an antenna with a relaxed pattern. Use of both prongs avoids constraining the sharing regime for a system that has a relaxed antenna pattern but operates at low power, or that operates at high power but with a tight antenna pattern.

To accommodate high-power uplinks, SkyBridge has proposed the use of two different separation angles, with the larger angle applicable to in-line events involving at least one high power link.[9] In particular, SkyBridge proposed that the separation angle for in-line events involving at least one high-power system be 20°.[10] The goal was to ensure that systems

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applicants vary considerably (from LEO to HEO) means that the uplink powers of the proposed systems span a significant range.

[8] SkyBridge January 2002 *Ex Parte* at 22. To arrive at the formula defining a "high-power" system, SkyBridge examined the 10° off-axis EIRP density in 40 kHz, and the on-axis EIRP density in 40 kHz, for the proposed systems, to the extent this information could be readily extracted from data in the FCC applications. The SkyBridge proposal represents the *average* of the power levels obtained. Therefore, a system would be defined as "high power" if *both* its off-axis power (reflecting antenna side-lobe levels) and its on-axis power (reflecting uplink power levels) are greater than average for the systems under consideration.

More detailed studies of the information contained in the FCC applications could easily result in different definitions. However, as in the case of the selection of 10° as the baseline separation angle, any definition will be inherently arbitrary. So long as the definition of "high power" uplink adequately identifies those links (and only those links) that pose a threat to lower power systems at separation angles greater than 10°, the definition will serve its purpose.

[9] SkyBridge January 2002 *Ex Parte* at 24.

[10] The 20° angle was based on data provided to the Commission in an *ex parte* filing, which indicated that such an angle would not have a debilitating impact on any system, while still

would be adequately protected against higher-power systems, without overly burdening all systems by unnecessarily increasing the percentage of time during which satellites would be considered "in-line."

This technique has the important advantage of avoiding design constraints on the systems. However, as the Commission pointed out, it may not be an optimum approach when applied to a high-power system that, for whatever reason, has little incentive to coordinate.[11] Absent such incentive, or any constraint on power, an operator may substantially impede the operation of lower-powered systems.[12] Therefore, it would be desirable to ensure that all systems have an incentive to coordinate.

One way to achieve this result would be to employ SkyBridge's definition for a "high power" system not as a trigger for 20° separation, but as a coordination trigger. Under

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providing an incentive to coordinate. *See Ex Parte* of SkyBridge, ET Docket No. 98-206, March 27, 2001, Table 2, at 9-10. Like the 10° benchmark, the proposal of 20° is inherently somewhat arbitrary. So long as the incentive to coordinate exists, cooperation among the licensees should lead to more optimized solutions, customized to the actual operating parameters of each of the deployed systems.

[11] As the Commission noted, "imposing a wider angle for some systems may discourage coordination between parties, because a system that can operate under the 'benefit' of a wide-angle trigger has no incentive to coordinate with other systems, thus restricting those systems' ability to use the entire Ku-Band spectrum." FNPRM, ¶ 89. The Commission also observed that "employing two different angular separation measures may encourage the use of system parameters that are inefficient and result in limiting spectrum available to other systems." FNPRM, ¶ 89. One scenario in which the incentive to coordinate, and to use efficient system parameters, could fail is the case of a system that plans to use half or less of the spectrum. Such a system would be unaffected by "in-line" events, and may not have proper incentives to optimize the sharing regime. For all of these reasons, SkyBridge agrees with the Commission that, in accommodating high power systems, it would be desirable to preserve incentives for such systems to reduce, to the extent feasible, off-axis power through the use of lower power or better antennas, and to preserve incentives for coordination.

[12] Because all systems would have to use a larger separation angle for in-line events with high-power systems, high-power systems can impose longer "in-line" events on low-power

such a scenario, an operator proposing to employ high-power uplinks would be required to coordinate in good faith with other operating systems to agree on a reasonable separation angle (which could be greater than 10°, if justified by the requirements of the high-power system). This should not substantially increase the burdens of any party, because even the 10° baseline proposal is meant to encourage such coordination. If coordination failed, the Commission could provide a default solution based on parameters of the subject systems. For example, the Commission could specify a 20° separation angle for the two operators (or such lower angle as appeared justified by the system parameters), with the caveat that the high-power uplink may not cause harmful interference to any other system.

In the FNPRM, the Commission suggests that imposing an off-axis PFD limit on NGSO FSS system uplinks may promote sharing, and may, in fact, eliminate the need for two separation angles. In particular, the Commission proposes a limit of -7 dBW/4 kHz.[13]

While such a limit may be very desirable in preventing a system from employing excessive power, such a step is unlikely to resolve by itself the concern regarding "high power" systems. This is because a limit that is sufficiently tight so as to allow all systems to share with a 10° separation angle is likely to impose design constraints on some systems. Conversely, a limit that does not impose significant design constraints is not likely to permit all systems to share with a 10° separation angle. While a power limit could help ensure that systems do not abuse the sharing regime established by the Commission by using excessive

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systems. Moreover, even the larger separation angle may not be sufficient to protect all low-power systems.

[13] FNPRM, ¶ 91. The text of the Commission's discussion of this issue addresses an off-axis PFD limit. However, the limit actually proposed appears to be a limit on the power fed into NGSO FSS earth station antennas. For the reasons provided infra, SkyBridge's comments on the proposal apply equally to either scenario.

power, any such limit should be implemented only in combination with the SkyBridge proposal described above.

III. COMPLIANCE WITH AGGREGATE $EPFD_{down}$ LIMITS

In the FNPRM, the Commission proposes to adopt newly developed ITU-R methodologies for assessing compliance with the aggregate $EPFD_{down}$ limits that are applicable to NGSO FSS systems collectively.[14] In particular, the Commission cites a Draft New Recommendation ("DNR") that ITU-R Working Party 4A developed and sent to ITU-R Study Group 4.[15] This DNR provides three methodologies for calculating aggregate $EPFD_{down}$ limits into GSO networks.

SkyBridge supports the methodologies developed by Working Party 4A. The three methodologies, of increasing complexity but also of increasing accuracy, ensure that compliance can be assessed in the most efficient fashion. If the simpler of the methodologies, which overestimate the interference, indicate that the aggregate limits are exceeded, the NGSO FSS operators can still turn to the more detailed methodologies to demonstrate compliance.[16]

It must be emphasized, however, that even though some of the methodologies described in the DNR are relatively simple to implement, it cannot be assumed that demonstrations of compliance will be simple in practice. Under the DNR, the NGSO operators

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[14] FNPRM, ¶ 86.

[15] Draft New Recommendation ITU-R S.[Doc. 4/62 (Rev.1)], "Methodologies for calculating aggregate $EPFD_{down}$ produced by multiple non-GSO FSS systems into a GSO FSS network," November 19, 2001.

[16] It is important to understand that the three methodologies (and 6 sub-methodologies) of the DNR are not intended as a "menu" from which an administration or other party seeking a demonstration of compliance is free to choose. The simpler methodologies overestimate the interference, potentially penalizing NGSO FSS operators whose systems may, in operation, meet the limits. The methodologies are intended as a progression. Any relevant regulation adopted by the Commission must take this into account.

are fully entitled to demonstrate compliance under the most complex of the methodologies, as these overestimate the interference by the least amount. These methodologies require substantial computer resources and may require proprietary information about the constellations. As a result, it can be expected that demonstrations may require a high level of cooperation among the operators, as well as very detailed descriptions of the constellations and operating parameters. For this reason, it is important that any requirement for demonstration of compliance be narrowly-tailored to situations in which a violation of the limits is a realistic concern.

As SkyBridge has explained previously, due to the mathematical relationship between the single entry and the aggregate limits, there can be no concern about violation of the aggregate limits until at least 3.5 NGSO FSS systems are operating co-frequency at full capacity. As the Commission recognized, this will take "a good deal of time."[17] No party has disputed either of these conclusions.[18]

Therefore, the Commission should not require a demonstration of compliance until a fourth NGSO FSS system seeks to deploy. In the meantime, the Commission could simply include in each license a statement putting the licensees on notice that, once a fourth system seeks to commence operations, the Commission may require all of the operating licensees to collectively demonstrate compliance using the most relevant ITU-R methodology

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[17] Id., ¶ 61.

[18] See, e.g., Comments of DIRECTV, Inc., IB Docket No. 01-96, July 6, 2001, at 3 ("DirecTV does not take issue with the specific reasons that the Commission has cited for deferring at this time the crafting of an explicit demonstration requirement with respect to NGSO FSS system compliance with aggregate EPFD limits."); Comments of Lockheed Martin Corporation, IB Docket No. 01-96, July 6, 2001, at 2 ("Lockheed Martin also believes that the Commission should clarify that the aggregate limit test need only be applied when the fourth and subsequent NGSO systems are considered.")

approved at that point in time.[19] Presumably this will be the DNR or its progeny. Such an approach takes into account the current immature state of development of many of the systems, while fully protecting the GSO operators operating in the shared bands in the event that more than three NGSO FSS systems commence co-frequency operation.

CONCLUSION

The steps outlined above will provide all of the Ku-band NGSO FSS applicants an equal opportunity to deploy their systems, as proposed in their applications, while protecting other operations in the subject bands. The proposals also simplify, to the extent possible, the regulatory burdens of the applicants and Commission. The Commission should therefore adopt these proposals.

Respectfully submitted,

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[19] SkyBridge Comments at 26. If a new entrant cannot be accommodated without causing a violation of the limits, the Commission should require all operators to equitably share the burden of taking the steps necessary (such as reducing power levels or number of beams) to permit entry of the licensed system in accordance with limits.